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Early record of indricothere (Mammalia: Perissodactyla: Hyracodontidae) from the Aral Sea region of western Kazakhstan

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Abstract.—Upper molar fragments of the indricothere rhinoceros *Paraceratherium* sp. are described from the Chilikta Formation at Altyn Chokysu, north of the Aral Sea in western Kazakhstan. Marine bivalves indicate the Chilikta Formation is of early Oligocene (Late Rupelian) age, and thus provide the first direct cross-correlation of an occurrence of *Paraceratherium* with the marine timescale. This find extends the temporal range of *Paraceratherium* in the Aral Sea region back from the late Oligocene to the early Oligocene, making it consistent with the temporal range noted for the genus in China. *Paraceratherium* thus had a geologically synchronous first appearance across Eurasia during the late early Oligocene.

The largest land mammals of all time were the indricotheres, giant rhinoceroses that lived during the early to middle Cenozoic in Eurasia. Indricothere evolution began during the middle Eocene with the pony-sized genus *Forstercooperia* and culminated during the Oligocene-early Miocene with *Paraceratherium* (=*Baluchitherium*, =*Indricotherium*), a rhinoceros that stood more than five meters tall at the shoulder, the largest land mammal of all time (Granger & Gregory 1936, Lucas & Sobus 1989).

One of the most important collecting areas for fossils of *Paraceratherium* is north of the Aral Sea in western Kazakhstan (Fig. 1). Here, the most nearly complete skeleton known of the genus was collected (Orlov 1939, Gromova 1959) from the Kumbulak Cliffs east of the town of Agyspe (Akespe) along Perovsky Bay on the northern shore of the Aral Sea. This and other specimens of *Paraceratherium* from the region north of the Aral Sea are restricted to the Aral Formation, strata of late Oligocene (Russell & Zhai 1987) or early Miocene (Akhmetyev & Sychevskaya 1994) age. Here we document a much older occurrence of *Paraceratherium* in this region that clarifies the temporal distribution of the genus. In this article, AMNH refers to the Department of Vertebrate Paleontology, American Museum of Natural History, New York; and USNM refers to the Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Stratigraphy and Provenance

North of the Aral Sea, four rock-stratigraphic units of Eocene-Oligocene are exposed (Akhmetyev & Sychevskaya 1994) (Fig. 2). The oldest, the Chegan Formation, is yellowish green, bentonitic marine shale with dinocysts and molluscs of late Eocene (Priabonian) age. The Kutanbulak Formation disconformably overlies the Chegan, is as much as 28 m thick and is composed of mostly yellow, orange and brown, fine-grained quartzarenite. It is unconformably overlain by the Chilikta Formation, as much as 23 m of shale and thinly interbedded shale-sandstone. The Chilikta Formation

Fig. 1. Map of Kazakhstan showing location of Altyn Chokysu north of the Aral Sea.

produces marine bivalves (especially *Ergenica cymlanica*) that correlate it to the Solenovo horizon of the Crimea-Caucasus of late Early Oligocene (late Rupelian) age (Akhmetyev & Sychevskaya 1994).

The Chagray Formation disconformably overlies the Chilikta Formation and is as much as 33 m thick and mostly yellowish gray and brown, micaceous sandstone. The Aral Formation conformably overlies the Chagray. It is at least 24 m thick north of the Aral Sea (its top is everywhere eroded) and consists mostly of grayish yellow green, calcareous shale and claystone characterized in its lower part by numerous lenses of the euryhaline bivalve *Corbula*. All fossil mammal localities reported by previous workers (Russell & Zhai 1987, Bendukidze 1993, Akhmetyev & Sychevskaya 1994) from north of the Aral Sea are in the Aral Formation. We follow Russell & Zhai (1987) in regarding these mammals as late Oligocene in age, but Soviet scientists regard them as early Miocene in age (Akhmetyev & Sychevskaya 1994).

The new locality at which we collected

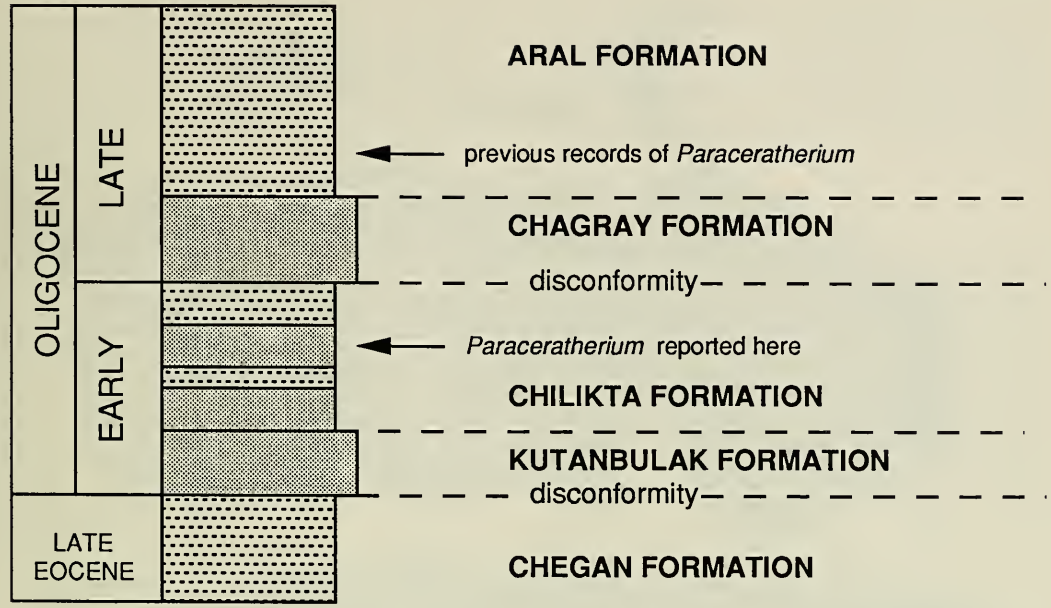

Fig. 2. Summary of Eocene-Oligocene stratigraphic units in Altyn Chokysu area showing stratigraphic levels of *Paraceratherium* occurrences (lithology schematic).

Paraceratherium tooth fragments is in the Ckilikta Formation on the escarpment of Altyn Chokysu, a plateau about 20 km northwest of the town of Saksaulskaya and about 70 km northeast of the Kumbulak Cliffs (Figs. 1–2). This locality is at UTM 3577371E, 5238795N, zone 41, stratigraphically well below Bendukidze's (1993) "Shokysu" mammal locality in the Aral Formation. The fossiliferous horizon is a 1.2-m-thick, white, fine-grained sandstone, 10.8 m above the base of the Chilikta Formation, which is 14.4 m thick at this location. The *Paraceratherium* tooth fragments were associated with a sirenian rib, fish bones and teeth of the sand tiger shark *Carcharias* sp.

Systematic Paleontology

Order Perissodactyla Owen 1848
Family Hyracodontidae Cope 1879
Subfamily Indricotheriinae Borisyak 1923
Genus *Paraceratherium* Forster Copper 1911

Paraceratherium sp.
Fig. 3

Referred specimen.—USNM 482243, approximately 50 fragments of cheek teeth, three of which, illustrated here, are parts of ectolophs of right M^1, M^2, and M^3.

Description.—The three largest tooth fragments, here referred to as 1, 2, and 3, are portions of upper molar ectolophs. Fragment 1 is right M^3 ectoloph from paracone through parastyle, and part of protoloph. Paracone forming thick rib on labial face of ectoloph and separated from parastyle by distinct cleft. Parastyle a more prominent and anteriorly-projecting rib. Ectoloph making sharp, nearly right-angled fold and becoming confluent with protoloph. Minimum crown height at paracone 59 mm.

Fragment 2 from anterior part of ectoloph of right M^2. Preserves paracone as a less prominent rib than on M^3 ectoloph. Cleft between paracone and parastyle less pronounced than on M^3. Paracone crown height about 66 mm.

Fragment 3 part of posterior portion of

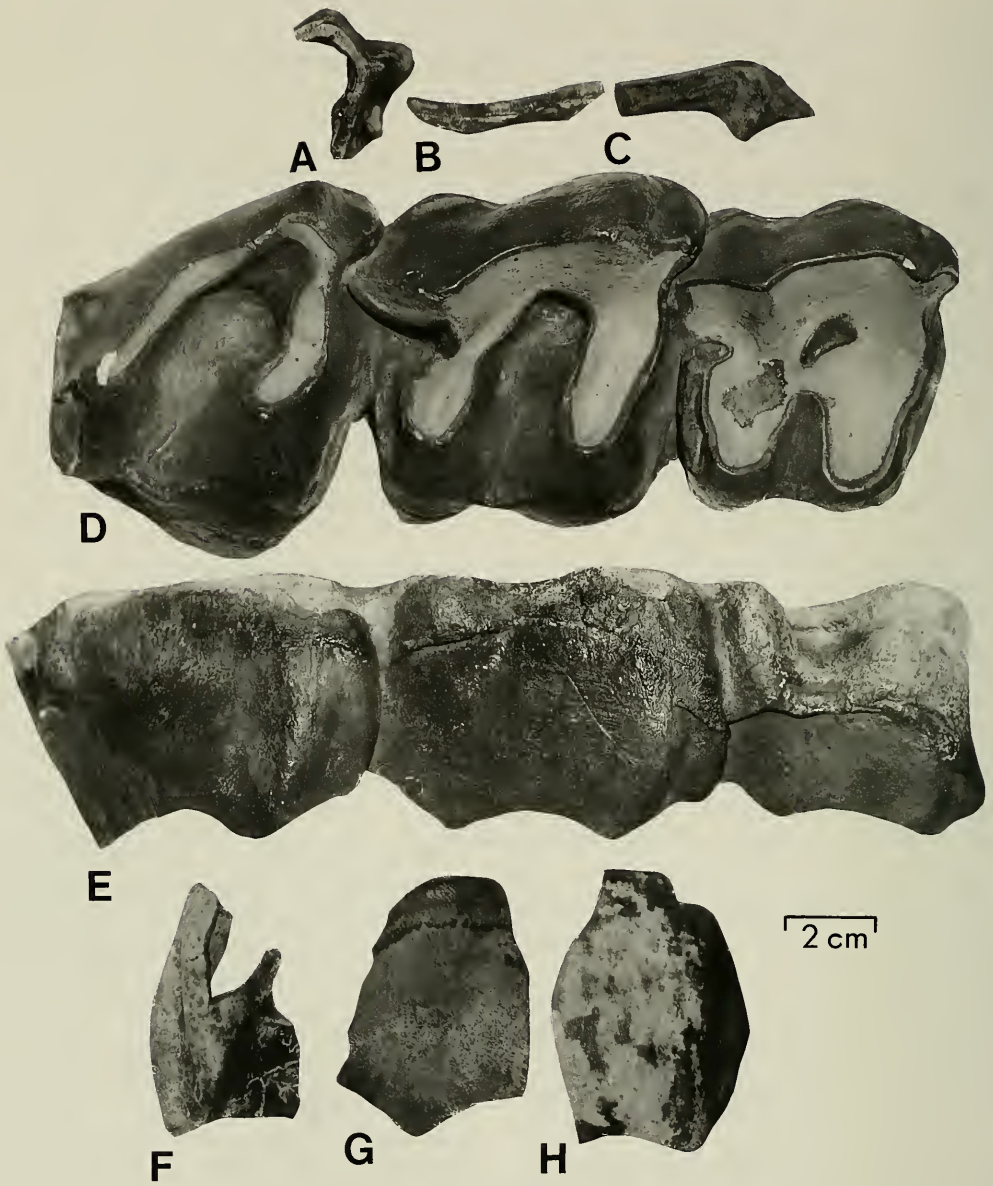

Fig. 3. Tooth fragments of *Paraceratherium* sp. from Altyn Chokysu compared to cast of holotype of *Paraceratherium asiaticum.* A–C, USNM 482243, *Paraceratherium* sp. from Altyn Chokysu: A, occlusal view of fragment of right M^3 ectoloph (fragment 1 in text); B–C, occlusal view of right M^2 ectoloph (fragments 3 and 2, respectively, in text). D–E, AMNH 26972, cast of holotype of *Paraceratherium asiaticum,* left M^{1-3} (photographs reversed): D, occlusal; E, labial views. F–H, USNM 482243: F, anterior view of fragment of right M^3 ectoloph (fragment 1 in text); G–H, labial views of fragments of right M^2 ectoloph (fragments 3 and 2, respectively, in text).

right M^2 ectoloph, probably from same tooth as fragment 2, but two pieces do not fit together. Blade-like metacone projecting from rest of ectoloph occlusal edge. Prominent basal cingulum on posterior edge of crown. Fragment 2 and 3 suggest total ectoloph length of more than 90 mm.

Identification.—We compared these

tooth fragments to casts of upper dentitions of *Paraceratherium asiaticum* from the Turgay region of central Kazakhstan (Fig. 3: Granger & Gregory 1936, figs. 2C–D). These casts are AMNH 26971, left P^2–M^3, and AMNH 26972, right P^2–M^2 (cast of holotype of *P. asiaticum*). They are very similar in size and morphology to the fragments we collected at Altyn Chokysu. Fragment 1 has a minimum crown height of 59 mm, about the same as that of AMNH 26971, which is nearly 61 mm. Fragment 2 has a paracone crown height of about 66 mm, the same as on AMNH 26971. All other rhinocerotoid genera are much smaller, so we assign USNM 482243 to *Paraceratherium* sp.

Discussion

Prior to this report, *Paraceratherium* occurrences north of the Aral Sea were restricted to the aral Formation and regarded as either later Oligocene or early Miocene in age. However, *Paraceratherium* occurrences as old as late Early Oligocene ("middle" Oligocene of some authors) are well documented in Nei Monggol, China, and the genus occurs in strata as young as late Oligocene (Russell & Zhai 1987). Specimens reported here establish a temporal range of *Paraceratherium* in western Kazakhstan coeval to that in China. They thus eliminate the possibility that *Paraceratherium* first arose in China and only reached central and western Asia (Kazakhstan) much later.

Occurrence of *Paraceratherium* in the Chilikta Formation also provides the first direct correlation of this mammal's record to the marine timescale. As stated above, marine bivalves indicate the Chilikta is late Rupelian in age. This may be the oldest age reported for the genus *Paraceratherium* across Asia. *Paraceratherium* has its youngest occurrence at Bugti in Pakistan, where it is of early Miocene age (Raza & Meyer 1984). *Paraceratherium* thus emerges as a much longer-lived genus than indicated by Lucas (1994), who assigned it a late Oligocene-early Miocene age. The genus has a range of nearly 10 million years, spanning the late Rupelian (about 30–32 Ma) to early Miocene (about 20–22 Ma).

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